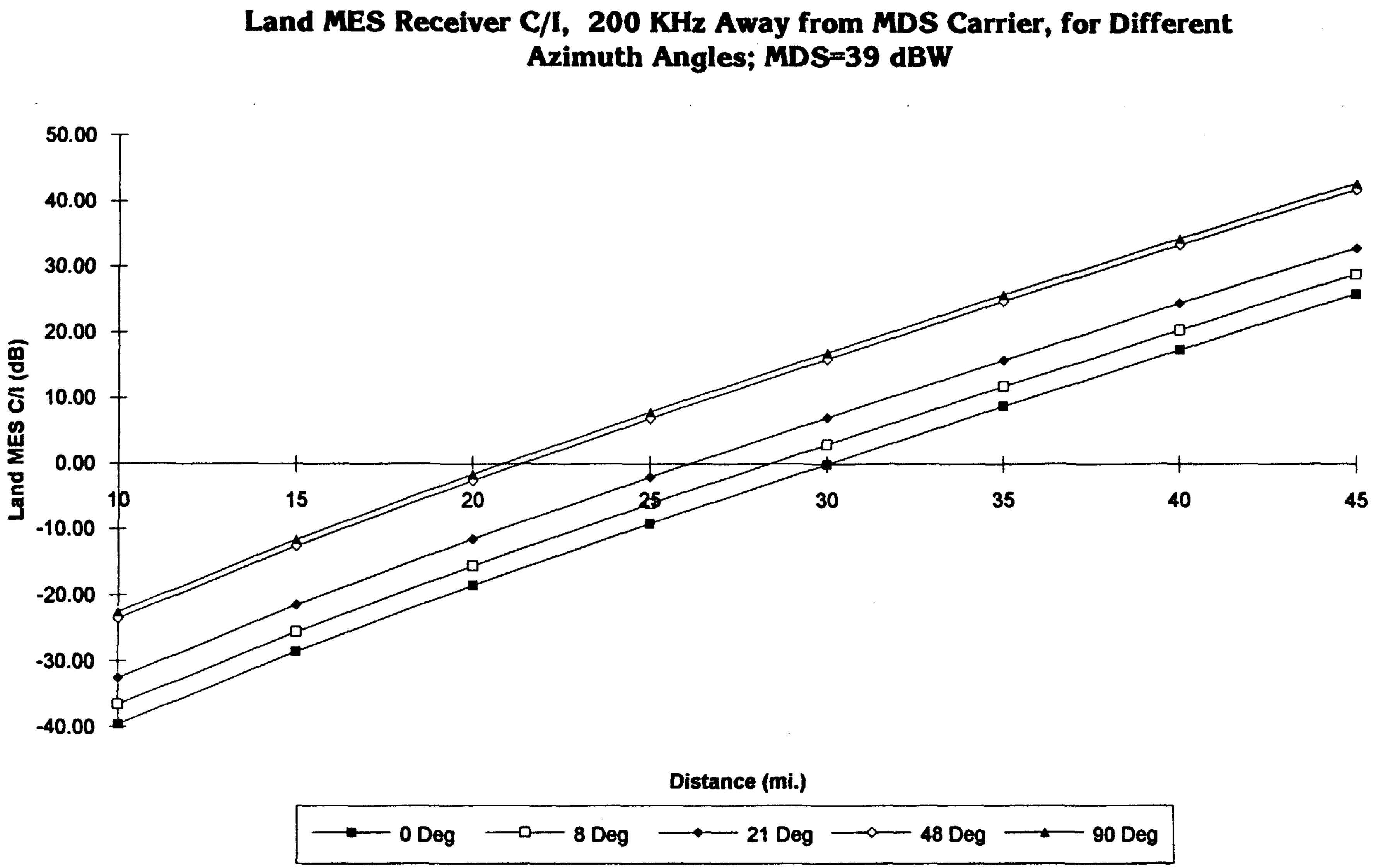
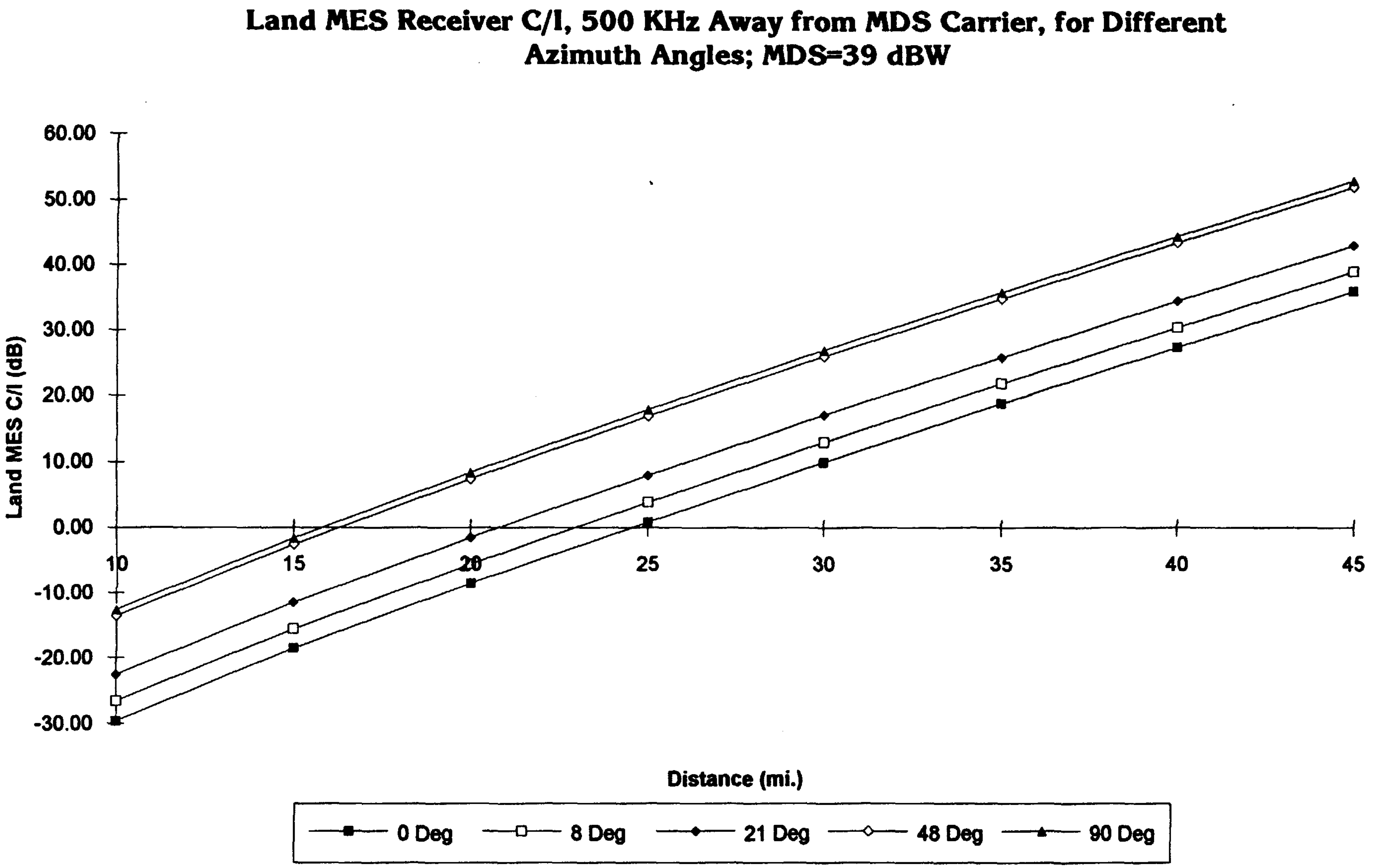
Figure 4B



C/I=(Sat EIRP-PL+MES Rx Ant G)-(TV Carrier EIRP-Terr PL-Fad/Shad Loss+MES Rx Ant G(Az)-Xpol)

MDS2MSS4.XLC

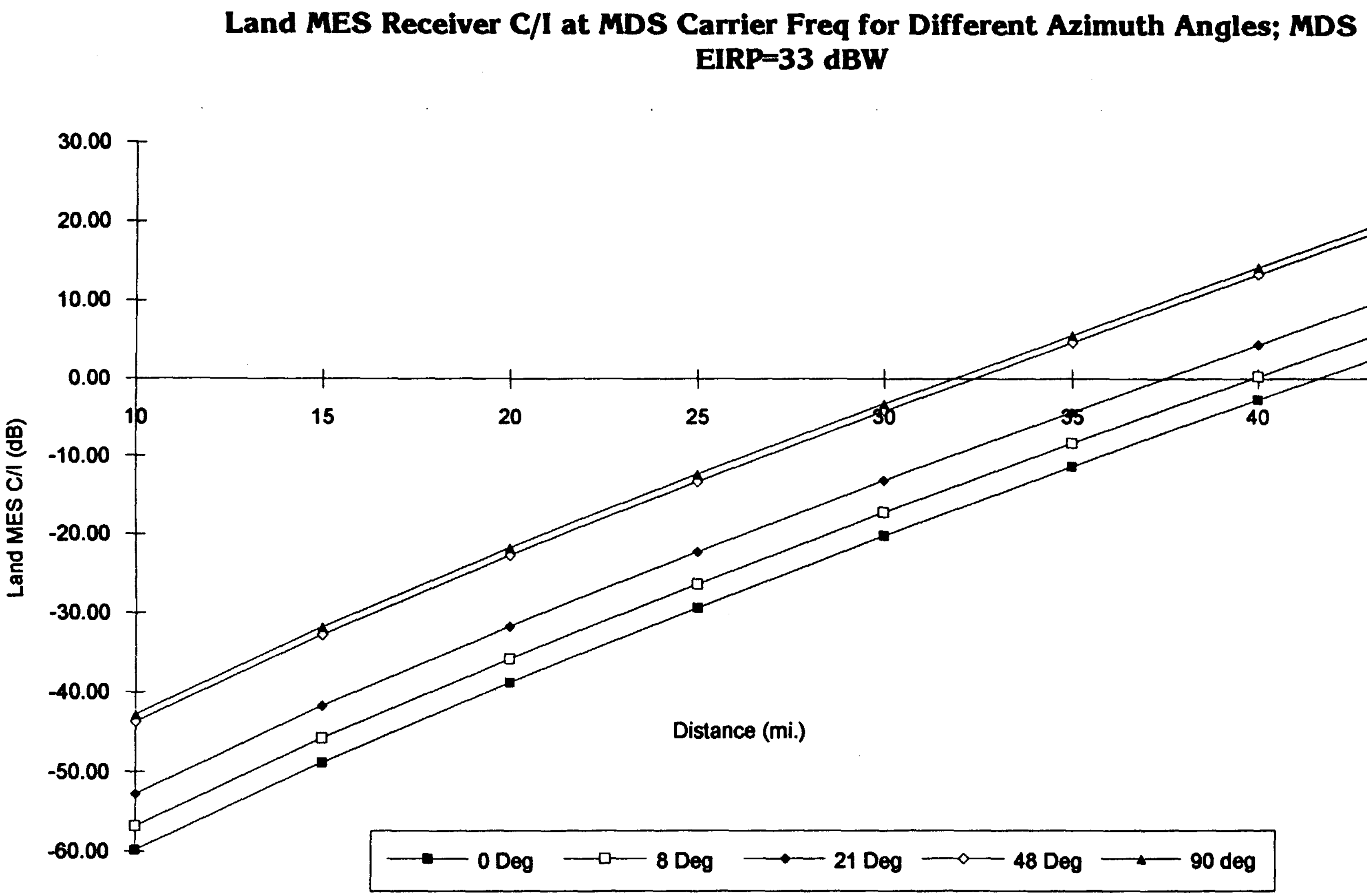
Figure 4C



C/I=(Sat EIRP-PL+MES Rx Ant G)-(TV Carrier EIRP-Terr PL-Fad/Shad Loss+MES Rx Ant G(Az)-Xpol)

MDS2MSS5.XLC

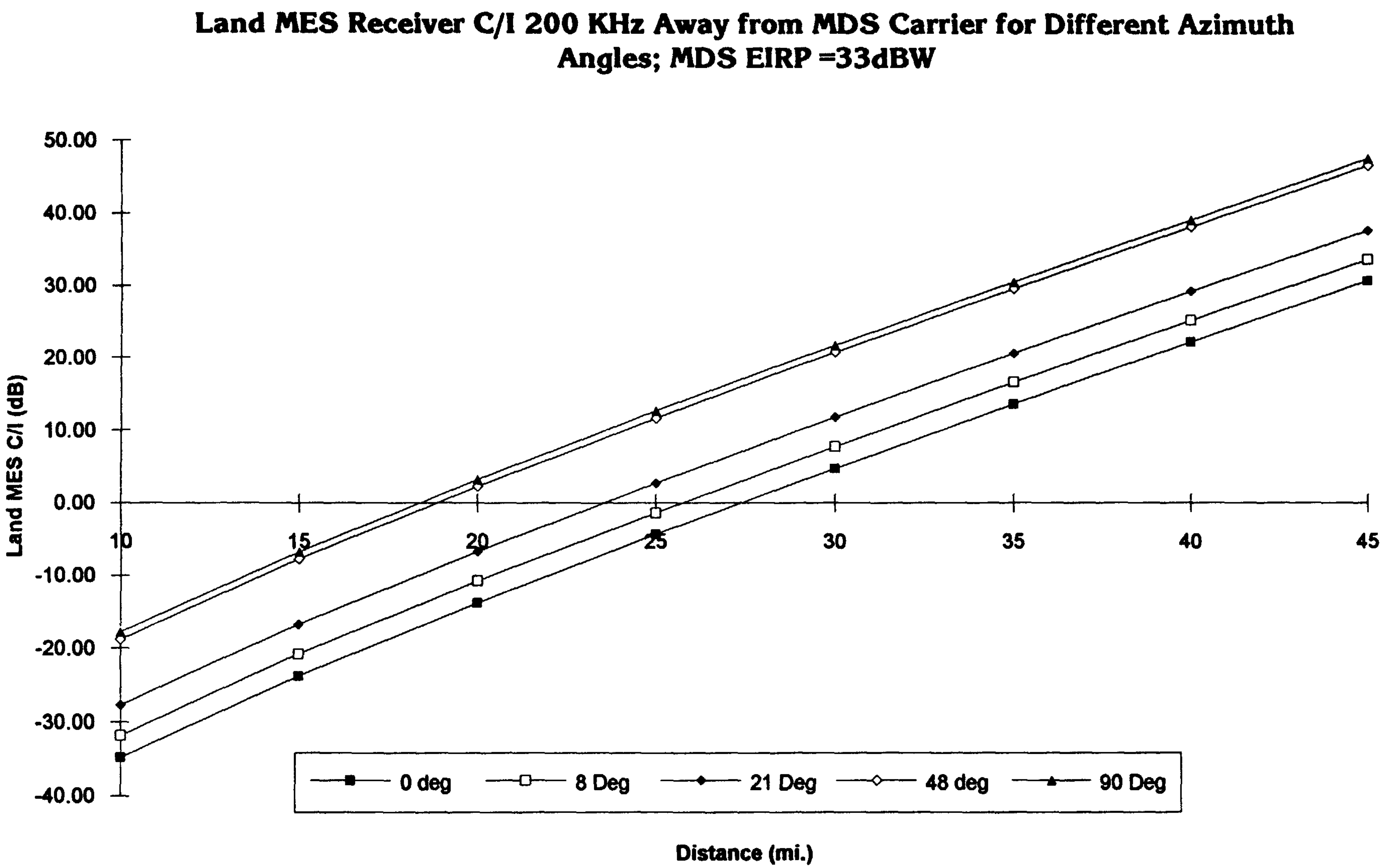
Figure 4D



C/I=(Sat EIRP-PL+MES Rx Ant G)-(TV Carrier EIRP-Terr PL-Fad/Shad Loss+MES Rx Ant G(Az)-Xpol)

MDS2MSS0.XLC

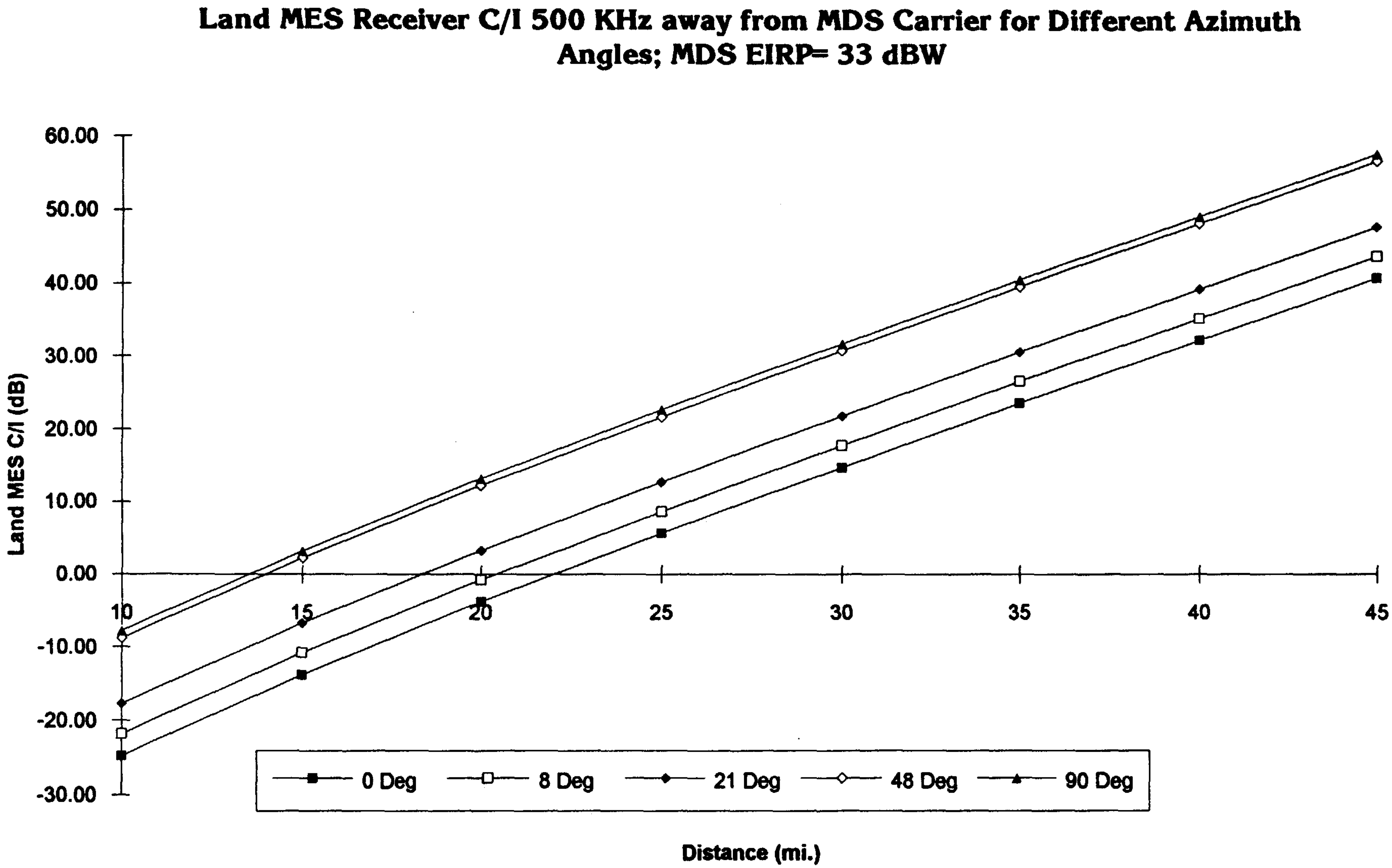
Figure 4E



C/I=(Sat EIRP-PL+MES Rx Ant G)-(TV Carrier EIRP-Terr PL-Fad/Shad Loss+MES Rx Ant G(Az)-Xpol)

MDS2MSS1.XLC

Fifure 4F



C/I=(Sat EIRP-PL+MES Rx Ant G)-(TV Carrier EIRP-Terr PL-Fad/Shad Loss+MES Rx Ant G(Az)-Xpol)

MDS2MSS2.XLC

transmitter and LMSS receive antenna main beam axis, plus the placement of the LMSS carrier with respect to the MDS spectra. (Note, a terrestrial shadowing/fading loss of 1.5 dB/mile and a 3 dB polarization discrimination were also assumed in the interference calculations.) First, a co-channel calculation was made. The calculation was repeated for the two maximum allowable levels of 33 and 39 dBW for omni-directional and directional MDS transmitter antennas, respectively. Figures 4A and 4D show the resulting C/Is for land mobile terminals which are co-channel with an MDS video carrier. The C/Is are negative until separation distances of 40-45 miles are reached.

To determine the effect of frequency offsets, the calculations were also repeated for ±100 KHz and ±250 KHz frequency offsets between the desired Standard M carrier and the MDS picture carrier. Since all MDS signal components which are beyond ±100 KHz/±250 KHz of the picture carrier are 25 dB and 35 dB down, respectively from the carrier, the C/I's improve by this amount. See Figures 4B, 4C (MDS interference at 39 dBW) and Figures 4E, 4F (MDS interference at 33 dBW); respectively.

2.3 <u>Discussion</u>

To summarize, the C/Is for LMSS mobile terminals will <u>not</u> facilitate sharing at separation distances of less than 40-50 miles, depending on the azimuth angle to the MDS transmitter, when the <u>MDS is exactly co-channel with the (Figure 4A, 4D) with LMSS carriers</u>. However, as seen in Figures 4B, 4C, 4E, and 4F, the 200 KHz (±100 KHz) or 500 KHz (±250 MHz) offsets reduces considerably the amount of geographic separation which would be needed to protect LMSS mobile terminal receivers: separation distances as low as 20-30 miles present usable C/Is which would facilitate sharing. The scenario COMSAT envisages is LMSS operating in rural areas while MDS would be concentrated in urban areas. This is a reasonable scenario because satellite links would not be competitive in areas where terrestrial communication is available.

Therefore, in view of the above, it is consistent to project a favorable sharing potential for these two services, the MDS and MSS. In addition, there are only (now), according to the OET Report 163 MDS facilities operating nationwide, mainly to supply video programs to subscribers over city-wide areas, and in some rural areas where it is not economical to install cable TV service. The primary frequencies allocated for MDS/MMDS are located in the 2.596 to 2.644 GHz band and many more assignments are being made to this service in this part of the spectrum.

B. Sharing Between Future MSS and Other Terrestrial Services

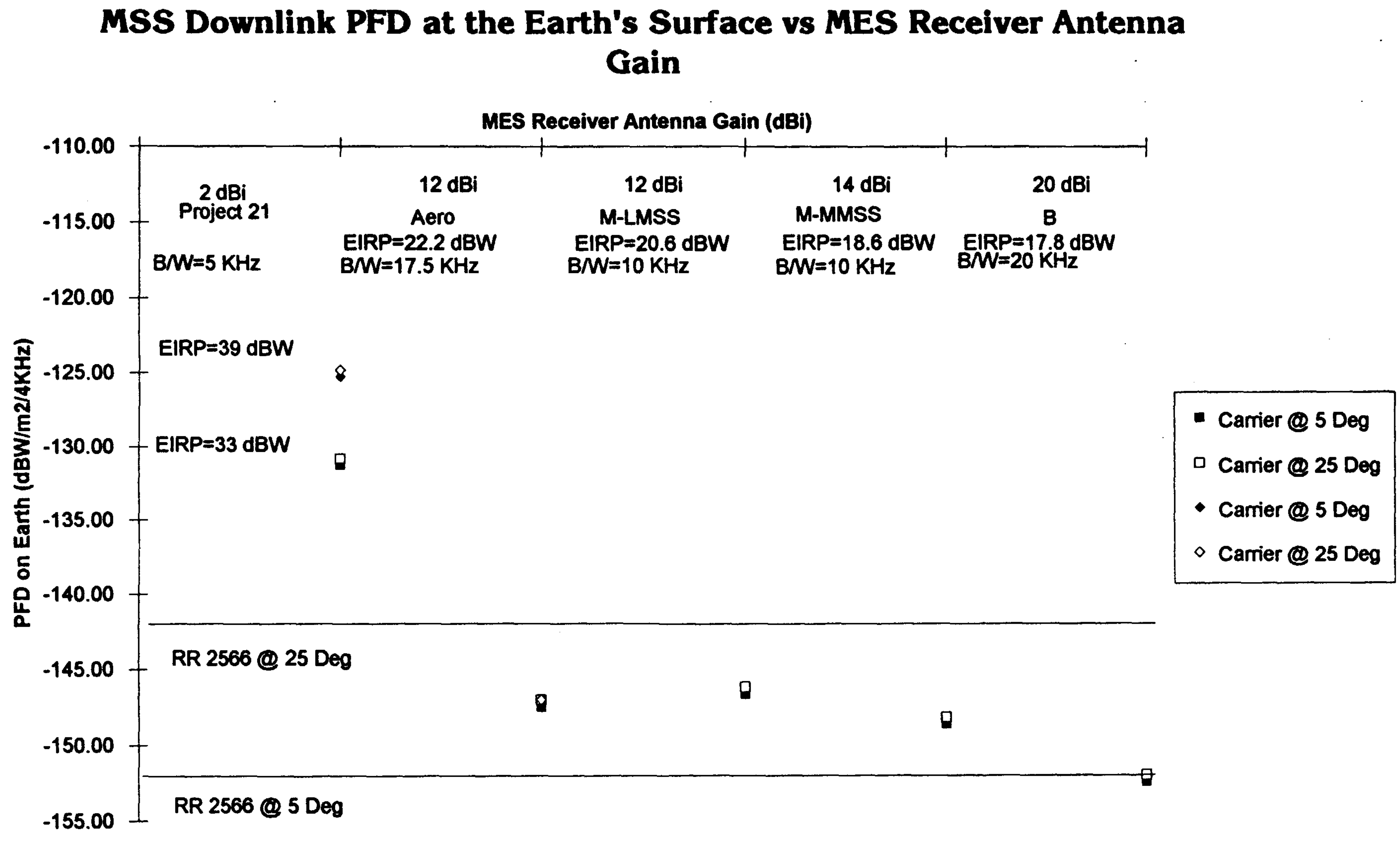
COMSAT is aware that there is a wide range of fixed terrestrial services operating at 2 GHz which may remain in these bands for some time, even though the Commission has slated microwave fixed operations, other than auxiliary broadcast and MDS services as candidates for re-location to other bands. These services, could impact MSS, and vice versa, if INMARSAT or another MSS operator were to introduce new satellites in these bands, prior to the re-accommodation of these services in other frequency bands. However, there are various factors, which would make it possible for MSS to share with the various fixed services on a transitional basis.

1. Effect Of MSS Downlink Interference Into FS Stations

Prior to WARC-92 the U.S. preparatory/technical committee and the CCIR/Study Group 8 & CCIR/JIWP considered sharing of MSS with Fixed services (FS). The central issue in these fora was the effect of satellite downlink interference into FS as function of satellite downlink radiation, as measured by the Power Flux Density (PFD) limit at the Earth's Surface, in $dBW/m^2/4$ KHz.

The operational PFD level required to "meet" a given C/No objective on a satellite downlink is a function of: the required transmission rate, the occupied RF bandwidth, the MES antenna gain and required link margin. Figure 5 depicts examples of PFD levels to be expected from typical INMARSAT-3 downlink carriers for voice transmission: Standard B/M (MMSS/LMSS) and AERO voice carriers (spot beam parameters) as well estimates for Project 21 Standard P voice carriers. Figure 5 also shows the 5 degree and 25 degree angle of arrival PFD level associated with Radio regulation 2566. WARC-92 invoked RR 2566 in international footnote 746X, pursuant to the coordination and notification procedures set forth in Resolution COM5/8. In the band 2160-2200 MHz coordination of space stations of MSS with respect to

Figure 5



PFD=Sat EIRP-Spread Loss-10log(BW/4000)

PFDGAIN2.XLC

terrestrial services is required only if the PFD produced at the Earth's surface exceeds the limits in RR No. 2566. This regulation applies to both geostationary and LEO satellites transmitting space stations operating in the 2160-2200 MHz bands.

This regulatory stipulation by the ITU that future MSS satellites which intend to use the new 2 GHz MSS bands must coordinate downlink emissions with terrestrial services if the RR 2566 PFD levels are exceeded, should in itself ease the concerns of terrestrial operators.[8] As seen in Figure 5, current INMARSAT-3 spot beam per carrier EIRP values would exceed the 5 degree trigger PFD level if translated to the 2 GHz bands. However, the INMARSAT-3 operational PFD levels at angles of arrival of 25 degrees or more are well below the RR 2566/25 degree PFD threshold. (Project 21 PFD levels are discussed below).

Additional CCIR analyses (Study Group 8) reveal that there could be excess interference to some types of 2 GHz fixed links if the receive antennas of these links "see" an MSS satellite at angles below 5 to 20 degrees. However, above 20-25 degrees, the interference levels from typical MSS downlink carriers would be acceptable to most types of terrestrial microwave links in the 2 GHz bands. In connection with this angle of arrival dependency,

---

[8] The PFD "trigger" limits are -152 dBW/m²/4KHz at angles of arrival between 0 and 5 degrees, and a sliding value of PFD tapered up to the higher level of -142 dBW/m²/4 KHz for angles of arrival equal or greater than 25 degrees.

preliminary COMSAT Labs and INMARSAT Directorate Project 21 studies indicate that acceptable LMSS links margins for hand-held transceivers will be in adequate for elevation angles less than about 20 degrees, due to the likelihood of blockage by terrain features and foliage. Therefore, it is reasonable to conclude that INMARSAT or another MSS operator would logically select an orbital location (90W) for CONUS LMSS operations, because that orbit location results in elevation angles exceeding 20 degrees. Such an orbit location also turns out to give the maximum protection to fixed service receive stations sharing the band with MSS--since the PFD levels for INMARSAT-3 type MSS carriers are below RR 2566 at such angles. Nevertheless, Project 21 PFD levels will be 10 to 15 dB higher. COMSAT notes that there is also considerable evidence that PFD limits such as RR 2566 are overly conservative for the case of MSS sharing with the fixed service because such limits were derived on statistical models of interference from an array of FSS satellites closely spaced in the GSO orbit every 3 degrees. Whereas, typical MSS satellites cannot be spaced closer than about 45 degrees for effective frequency reuse with respect to each other. Thus, it is still possible for FS to share with MSS even with Project 21 higher PFD downlinks.

2. MSS Sharing With Future Terrestrial Personal Communications Systems (PCS)

It is difficult to develop a model for MSS sharing with future, terrestrial Personal Communications Systems (PCS), since studies are still in progress to define the ideal characteristics of PCS. However, in the CCIR, there has been extensive groundwork laid to define a framework for PCS in what is known as Future Public Land Mobile Telecommunications System (FPLMTS).[9] While standards for FPLMTS have not been finalized yet, some sharing criteria have been developed.[10]

Our preliminary analysis shows that FPLMTS could co-exist with low to medium power density MSS downlink carriers, such as Standard M/INMARSAT-3, operating in the 2 GHz bands. However, if INMARSAT were to uses Standard P carriers with a Project 21 type satellite, the estimated PFD levels, as shown in Figure 5 appear to exceed the maximum (10% thermal noise) budget for external interference at a distance equivalent to about 1/3rd the indoor personal units maximum range to approximately 3/5th the outdoor personal units maximum range. These numbers tend to indicate that there could be a considerable economic impact on the development of FPLMTS, if this service develops in the MSS portions of the 2 GHz bands. This is because FPLMTS systems would need to incorporate many more base stations to reach a single personal unit in the presence of MSS downlink interference than would otherwise be necessary. Therefore, COMSAT recommends

---

[9] The FPLMTS concept involves terrestrial mobile stations (R1 interface), indoor and outdoor personal stations (R2 interface), mobile satellite stations (interface R3) and paging receivers (interface R4).

[10] See CCIR Report 1153, IWP 8/13-54 (renumbered IWP 8/15-6).

that the Commission not encourage the introduction of terrestrial PCS within the MSS downlink bands at least in the development of the Emerging Technology 1850-2200 MHz bands.

2.1 Calculation Methodology: MSS Interference into FPLMTS

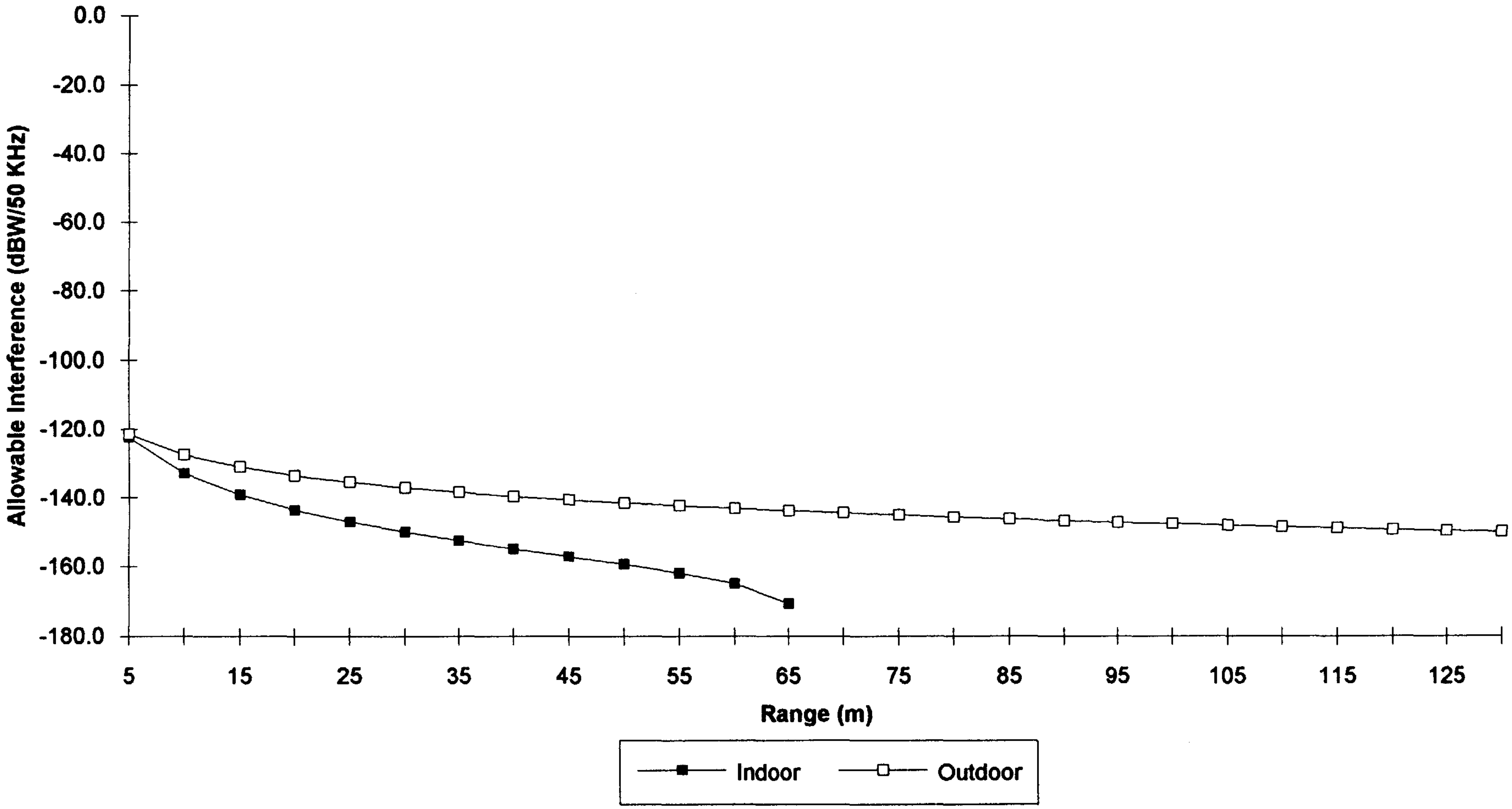
COMSAT conducted its analysis in the following manner. Since the personal stations are the dominant feature of FPLMTS, we compared the receive levels at the FPLMTS base station from the personal stations to that of potential interference levels from MSS downlink emissions. Typical link budgets for FPLMTS personal indoor/outdoor station links personal communication (to base station) shown in ANNEX 1, were used as the basis for computing permissible levels of interference to FPLMTS. The level of interference to FPLMTS that can be tolerated can be estimated using this link budget (from CCIR IWP 8/13). Note that both the base station transmit antenna gain and mobile personal station receive gain antenna is 0 dBi. The path loss for either indoor or outdoor links is a function of range between the FPLMTS mobile terminals and its base station. This path loss is inverse square/free space for the outdoor path and a higher order exponent for the indoor propagation at 2 GHz frequency as follows:

Indoor $\quad Loss(r) = 21.0 + 35*LOG(r)$; r, range, meters

Outdoor $\quad Loss(r) = 38.5 + 20*LOG(r)$; r, range, meters

Figure 6A

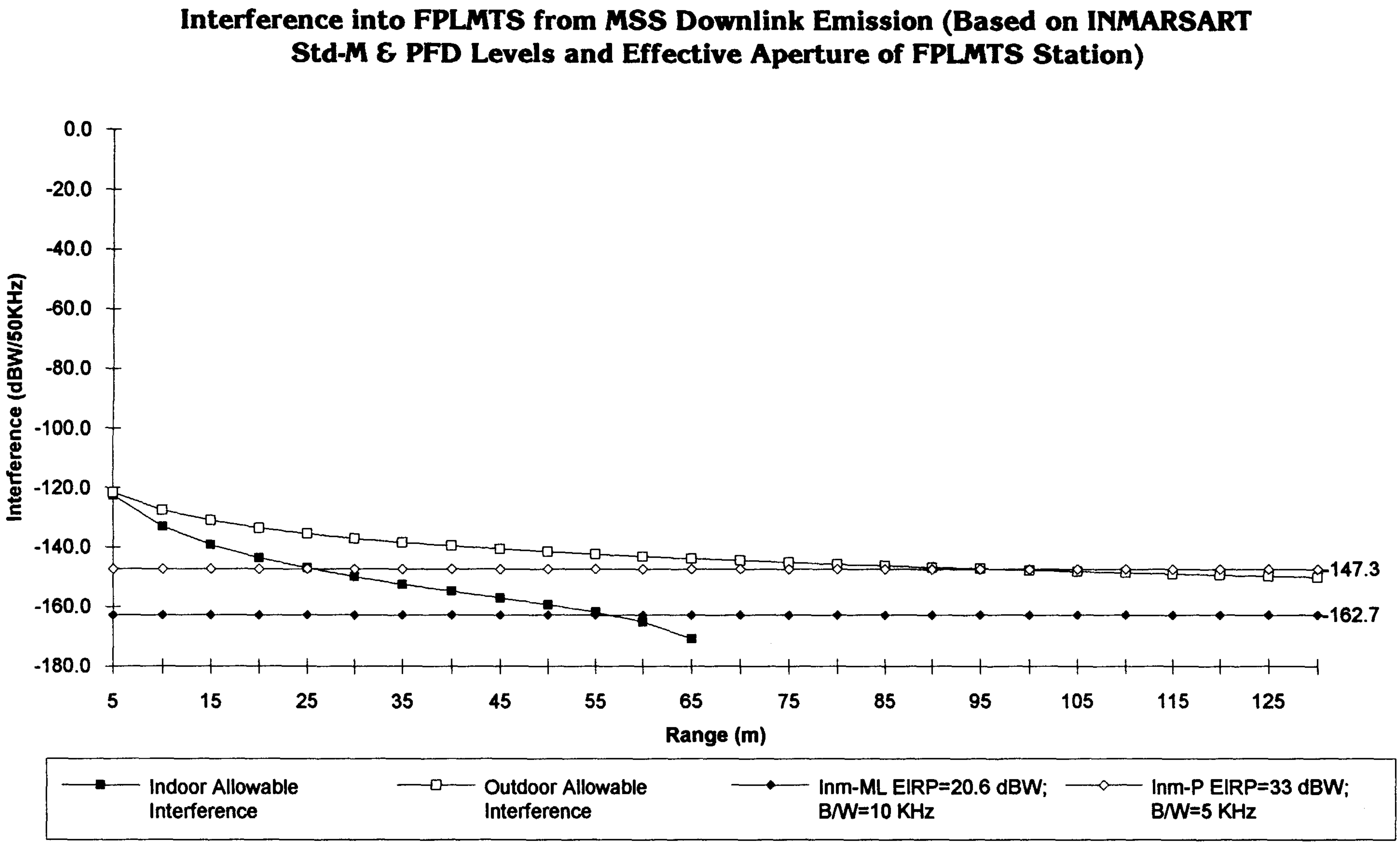
CCIR Estimated Allowable Interference into FPLMTS Base Station vs Range from Indoor /Outdoor Personal Stations



Indoor I=-98+10log(R**-3.5-10**-6.4); Outdoor I=-107.5+10log(r**-2-10**-5.45)

ALLOWINT.XLC

Figure 6B



Inm-ML I=Inm-ML PFD+(20logL+10logP-10log4Pi); Inm-P I=Inm-P PFD+(20logL+10logP-104Pi)

ALLOWI5.XLC

The maximum operating range is 67 meters for the indoor personal links and 133 meters for the outdoor links. Note also that the R2 indoor transmitter EIRP is only 3 mW (-25 dBW) and the outdoor transmitter EIRP is 20 mW (-17 dBW). The assumed thermal noise (N = KTB) in 50 KHz bandwidth and with a 5 dB noise figure receiver is -152 dBW and resulting minimum required carrier to total noise plus interference ratio, C/(N+I), is 13 dB. The minimum received carrier level for FPLMTS is also based upon a 14 dB shadowing margin for 95% coverage of the cell periphery when shadowing obeys a log normal distribution with a standard deviation of 8 dB and a 15 dB fade margin for less than 0.1% outage time during a call, using two channel diversity/Rayleigh fading distribution. The resulting allowable interference, as a function of range, into FPLMTS receivers is shown in Figure 6A. Using the previously calculated PFD levels expected from either an INMARSAT-3 Standard M downlink carrier or an advanced Project 21 P-sat carrier, (from Figure 5) and the effective aperture for FPLMTS receive antennas we calculated MSS downlink interference into FPLMTS and compared it to these allowable interference levels (as a function of range) shown in Figure 6 A. These MSS levels are super imposed on the allowable FPLMTS interference levels for comparison in Figure 6B. For Standard M type downlink carriers, there is negligible interference, because the PFD levels produce an equivalent signal well below the FPLMTS minimum allowable interference, practically out to the maximum range. However, for Standard P

ANNEX 1

This annex presents an example of a link budget to estimate the permissible levels of interference to the FPLMTS. The values in the table relate to a time division duplex, time division multiple access system.

PARAMETER			INDOOR PERSONAL	OUTDOOR PERSONAL
RANGE		r=	25	125 m
TRANSMIT POWER		Pt=	3 5	20 mW 13 dBm
BASE ANTENNA GAIN		Gt=	0	0 dBi
MOBILE ANTENNA GAIN		Gr=	0	0 dBi
PATH LOSS	(note 1)	Lp(r)=	70	80 dB
NOMINAL RECEIVE LEVEL			-65	-67 dBm
SHADOWING MARGIN	(note 2)	Ms=	14	14 dB
FADE MARGIN	(note 3)	Mf=	15	15 dB
MINIMUM RECEIVE LEVEL	(note 4)	C=	-94	-96 dBm
REQUIRED C/(N+Ii+Ie)	(note 5)	CNR=	13	13 dB
MAXIMUM (N+Ii+Ie)			-107	-109
BANDWIDTH		Bw=	50	50 kHz
THERMAL NOISE IN BW			-127	-127 dBm
NOISE FIGURE			5	5 dB
THERMAL NOISE		N=	-122	-122 dBm
TOTAL INTERFERENCE ALLOWANCE (Ii+Ie)			-107	-109 dBm
ASSUME 10% EXTERNAL INTERFERENCE MAX Ie			-117	-119 dBm

NOTES:

1. Lp(r) = 21 + 35 LOG (r) at 2 GHz suitable for an indoor office environment for ranges beyond a few metres.
   38.5 + 20 log (r) line of sight free space path loss for outdoor applications.

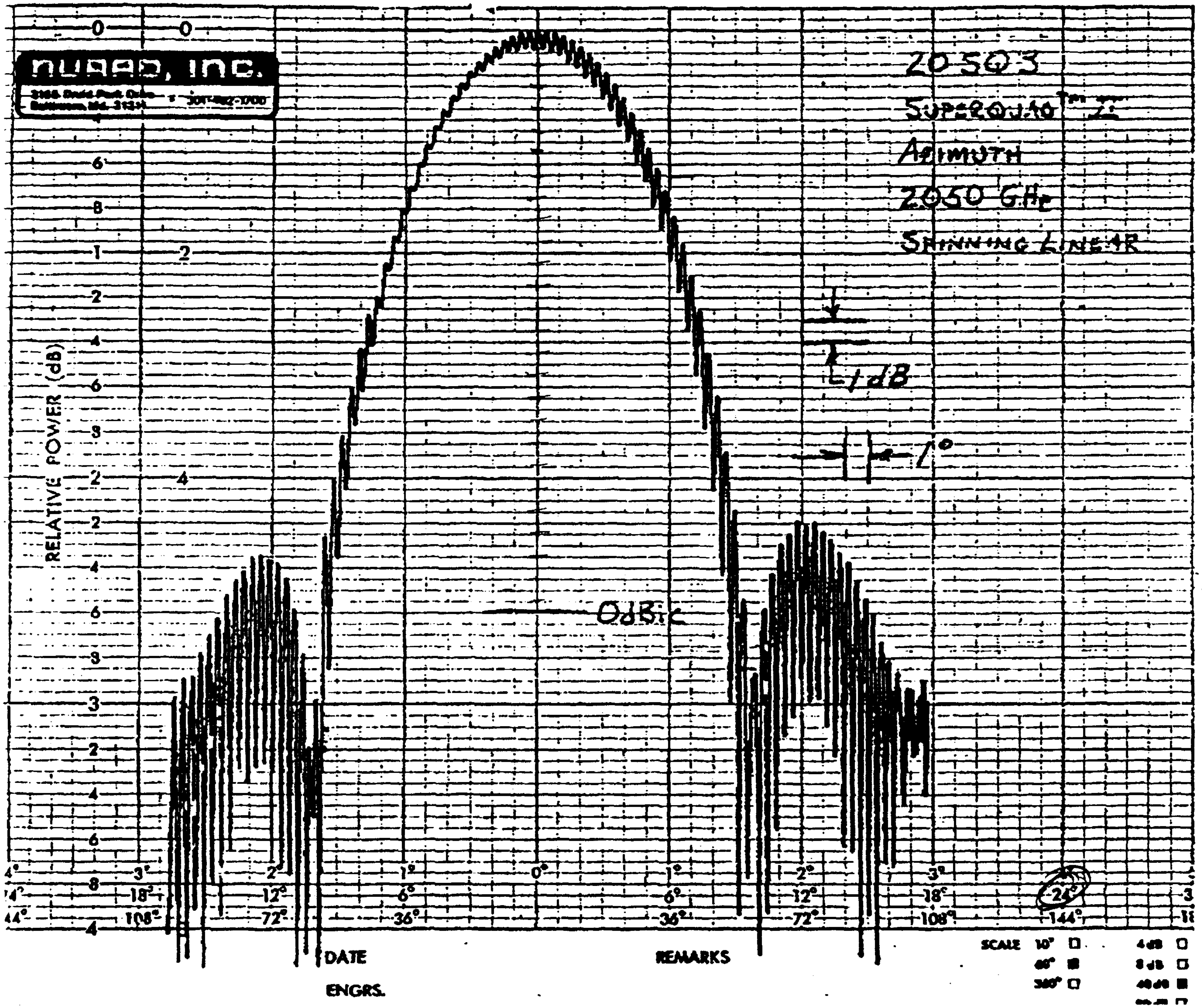
2. Ms = 14 dB for coverage of 95% of cell periphery when shadowing obeys a log normal distribution with a standard deviation of 8 dB.

3. Mf = 15 dB for less than 0.1% outage time during a call using two channel diversity where fading obeys the Rayleigh distribution.

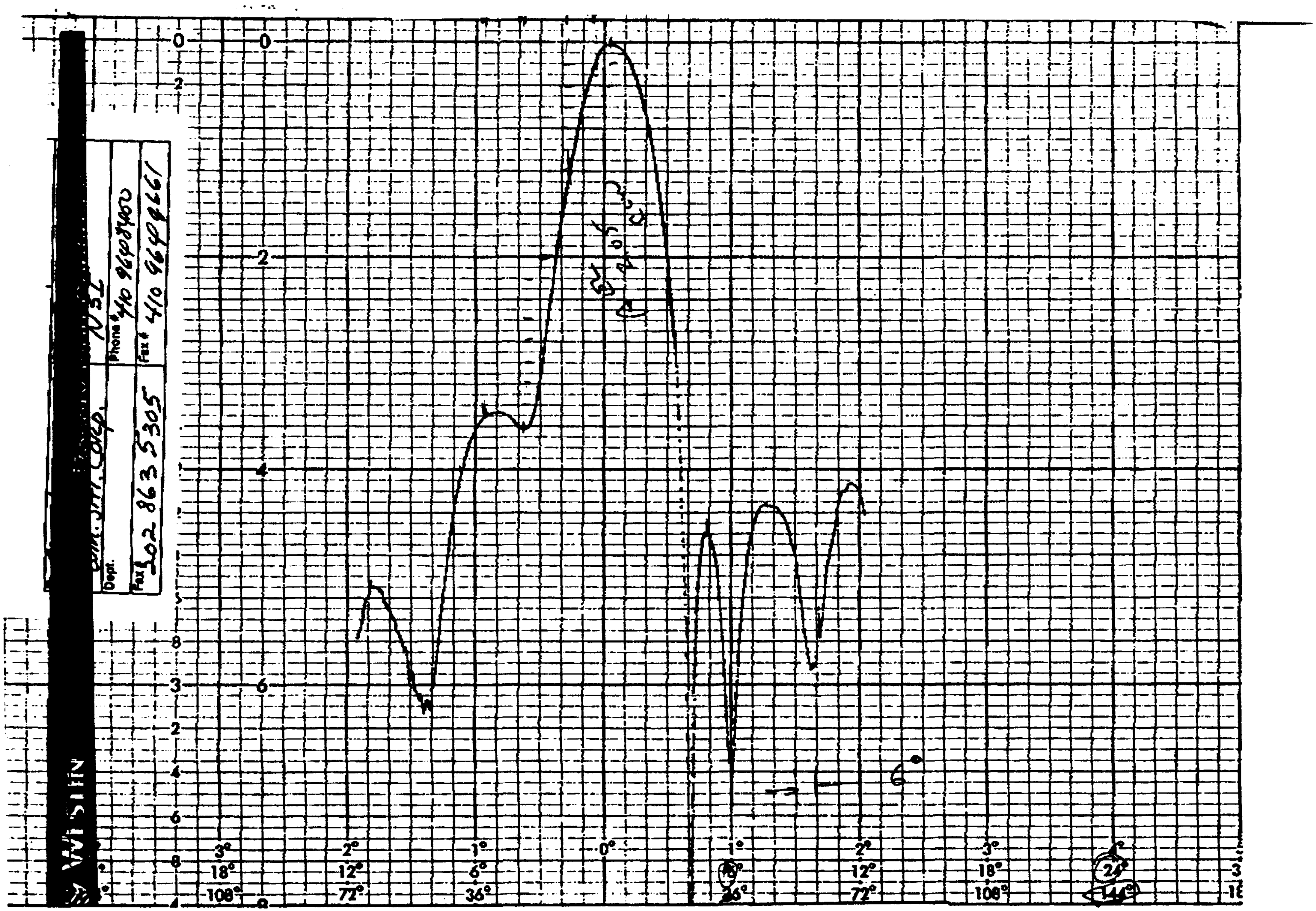
4. C = minimum received carrier power level.
   = P + Gt - Lp(r) - Ms - Mf + Gr

5. CNR = minimum carrier to total noise plus interference ratio.
   = C/)N+Ii+Ie)

ENG Receive Station Antenna Pattern in the Azimuth Plane at 2 GHz



ENG Mobile Unit Transmitting Antenna Pattern in the Elevation Plane at 2 GHz



type downlink carriers, producing 15 dB higher PFD levels in order to "close the link" with low-gain, hand-held MESs, the equivalent signal power from MSS represents the maximum allowable interference at a range of about 25 meters for the indoor unit (vs maximum range of 67 meters) and 90 meters for the outdoor unit (vs the maximum range of 133 meters). As summarized above, these reductions in range for the FPLMTS indoor/outdoor personal stations could have serious economic consequences for the development of the FPLMTS system overall. Therefore, COMSAT would not recommend FPLMTS sharing with MSS downlinks in the 2 GHz bands.

COMSAT did not attempt to estimate the FPLMTS interference levels to MSS satellites, which would be of interest if FPLMTS personal stations operated in MSS uplink bands. However, a Canadian DOC Interference Study[11] evaluated FPLMTS interference to MSAT, based on aggregate of estimated personal unit envision in 23 large (population above 100,000) Canadian metropolitan areas (high-density PCS cells), as seen at various off-axis angles between the satellite boresite and the metropolitan areas. This study concluded there is a potential sharing problem because C/No degradation as high as 1 dB (25% of the total noise budget) could result.

---

11 A study of the Magnitude of Potential Interference Between MSS and Fixed/Mobile Services in the Bands 1427-1525 and 1700-2500 MHz Final Report dated October 1990, Canadian Astronautics Limited. Report #CAL-RP-0596-10001.

CERTIFICATE OF SERVICE

I, Sandra M. Hunt, hereby certify that the foregoing "Comments" was served by hand, this 5th day of June, 1992, on the following:

Thomas P. Stanley
Chief Engineer
Federal Communications Commission
2025 M Street, N.W.
Room 7002
Washington, D.C. 20554

Will McGibbon, Chief
Spectrum Engineering Division
Federal Communications Commission
2025 M Street, N.W., Room 7130
Washington, D.C. 20554

William Torak
Deputy Chief
Spectrum Engineering Division
Federal Communications Commission
Room 7130
2025 M Street, N.W.
Washington, D.C. 20554

Wendell R. Harris
Assistant Bureau Chief
Common Carrier Bureau
Federal Communications Commission
1919 M Street, N.W., Room 534
Washington, D.C. 20554

*Larry Palmer
NTIA, 4th Floor
14th Street and Constitution Avenue, N.W.
Washington, D.C. 20230

*Richard D. Parlow
Associate Administrator
Office of Spectrum Management
NTIA, 4th Floor
14th Street & Constitution Avenue, N.W.
Washington, D.C. 20230

*Gregg Daffner
U.S. Department of Commerce
NTIA, Room 4701
14th & Constitution Avenue, N.W.
Washington, D.C. 20230

*Craig Moll
U.S. Department of Commerce
NTIA, Room 4701
14th & Constitution Avenue, N.W.
Washington, D.C. 20230

*Lon C. Levin, Esq.
Vice President and Regulatory Counsel
AMSC
1150 Connecticut Avenue, N.W.
4th Floor
Washington, D.C. 20036

Sandra M. Hunt

Sandra M. Hunt

*By First Class Mail